EXHIBIT 1

PAUL F. MCMANAMON, PH.D.

EDUCATION:

1977	Ph.D., Physics Ohio State University, Columbus, Ohio
1973	M.S., Physics Ohio State University, Columbus, Ohio
1968	B.S., Physics, magna cum laude John Carroll University, Cleveland, Ohio

PATENTS:

Balanced Mixer Laser radar receiver

PROFESSIONAL EXPERIENCE:

7/2008 - Present	**Center at the University of Dayton** *Technical Director of the Ladar and Optical Communications (LOCI)*
2008 – Present	**Exciting Technology, LLC** *Founder* Consulting
2005 – 2008	**Air Force Research Lab, AFRL, Sensors Directorate** *Chief Scientist* Lead the technical portfolio for the sensors directorate Personally instigated the Night Stare light program, which provide a night capability in under 1 year.
2000 – 2005	**Air Force Research Lab, AFRL, Sensors Directorate** *Senior Scientist, Infrared Sensors* ▪ Elected President of SPIE for 2006, and Vice President for 2005. ▪ Technically led numerous classified activities across a broad range of topics. Recognized by the director of a classified organization for his leadership as technical director of a major classified study effort. ▪ Led two Data Exchange Agreements with Israel.

- Significantly enhanced the in-house work in the Optical Phased Array area, including many papers he has personally authored.
- Originated a number of approaches to correct for the dispersion issues associated with Optical Phased Array Beam steering.
- Proactively resolved long standing organizational conflicts with another directorate
- Key participant on the Urban Panel of the AF SAB summer study 'Sensors for Difficult Targets". Wrote significant portions of the final report.
- Originated efforts to develop a revolutionary scaleable architecture for active EO systems, and to provide a common Radio Frequency/Electro-Optical aperture
- Began a unique effort to imaging through clouds.
- Selected to participate along with SAB members and a number of retired general officers in a high level technical review of a potential new laser radar effort
- He advised the Space Battle Lab on a complete program restructure of the Combat Eye effort. This converted a failing effort into success with a major breakthrough in the ability of electro-optical sensors to see through clouds.
- His technical leadership of the Electro-Optics Sensors and Countermeasures Thrust resulted in recognition of the Thrust as a national center of excellence as demonstrated by major successes in attracting new customer programs
- Suggested Medusa, a $80 M+ revolutionary DARPA program to prevent Infrared seeking missiles from being launched thus reclaiming the bottom 20,000 ft. of air space
- DARPA asked Dr. McManamon to have AFRL/SN be agent for major effort, the Synthetic Aperture Lidar Tactical Imaging program. This is an $84M technology program aimed squarely at the needs of AF war fighters.
- Initiated and obtained funding for a wide area 3D search effort, which may be instrumental in detecting and identifying targets under trees. A congressional plus up also occurred in this area.

1997 – 2000 **Air Force Research Lab, AFRL, Sensors Directorate**
Principal Engineer /Technical Director, Electro-Optical Sensors

- Technical lead of the development of electro-optical sensor and countermeasure systems.
- Obtained Ohio Grant for Optical Phased Array research.
- Participated in the "Roadmap for the 21st century Aerospace Force" SAB study. Technical Director of a significant black world study.
- Leading the Laser Radar Combat ID study effort in support of ACC and the new Advanced Targeting Pod (ATP).
- Began technical leadership role in the DARPA Steered Agile Beams (STAB) effort.

- Began a new multifunction Laser Radar effort.
- Responsible for the LASSOS underground sensing section.

1994 – 1997 **Avionics Directorate, Wright lab**
Acting Chief Scientist
- Technical lead for over 500 science & engineering personnel. Responsible for technical content of all electro-optical sensor development, microwave sensor development, Automatic Target Recognition, electron device development, and avionics systems, concepts, and simulation. In his 32 months as acting chief scientist for Avionics he worked across all sensor technologies, and created a productive team of division technical directors.
- Wrote significant portions of the Sensors panel New World Vistas SAB report. Acted as a member of the Sensors Panel of the New World Vistas SAB study. This was a major SAB study effort marking the 50th anniversary of the Air Force.

4/1993 – 11/1994 **Avionics Directorate**
Branch chief for the Electro-Optical Sensors Branch
Second level supervisor, supervising 3 to 4 groups, where at that time each group leader position was a supervisory position. Supervised about 50 people in the EO sensor technology area.

1987 – 1993 *Technical Expert for Electro-Optical Sensors*

1979 – 1987 *Group leader, Thermal Imaging / Passive Sensors Group*
First level supervisor of a group of 12 -15 people developing passive infrared sensor technology.

1977 – 1979 **Systems Avionics**
Electronics Engineer

5/1976 – 5/1977 **Avionics laboratory**
Laser development Engineer
Laser development Engineer working on flash lamp pumped dye lasers.

6/1973 – 5/1976 *Electronics Engineer* **in the area of Electro-Optical Countermeasure Systems**

9/1972 – 6/1973 Long term full time training at **Ohio State University.**

5/1968 – 9/1972 *Physicist / Electronics Engineer* **in the Electronic Warfare technical area.**

SELECTED PUBLICATIONS:

1. Laser radar: historical prospective –from the East to the West, V. Molebny, P. Mc Manamon, O. Steinvall, T. Kobayashi, W. Chen, Optical Engineering 56 (3), 031220-031220. 2017
2. A comparison flash lidar detector options. PF McManamon, P. Banks, J. Beck, AS Huntington, EA Watson. SPIE Defense+ Security, 983202-983202-19. 2016
3. High resolution non-iterative aperture synthesis. JR Kraczek, PF McManamon, EA Watson. Optics express 24 (6), 6229-6239 2016
4. McManamon, P.F. 2015. Field Guide To Lidar (SPIE Field Guide FG36) (Field Guide Series)
5. Ladar and Optical Communications Institute (LOCI) JW Haus, PF McManamon. Dayton University OH 2013
6. Qualitative evaluations and comparisons of six night-vision colorization methods. Y. Zheng, K. Reese, E. Blasch, P. McManamon. SPIE Defense, Security, and Sensing, 874511-874511-11. 2012
7. Photonic Innovations and Solutions for Complex Environments and Systems (PISCES) MJ Soileau, SJ Fonash, WJ Nam, L. Ji, V. Varadan, R Singh, GF Alapatt..Paul F. McManamon… 2012.
8. Superior data for superior information: multidiscriminate ladar. PF McManamon. SPIE Optical Engineering+Applications, 84820B-84820B-7. 2012
9. Instantaneously captured images using multiwavelength digital holography. JW Haus, B Dapore, NJ Miller, PP Banerjee, G. Nehmetallah, P. Power, P McManamon. 84930W-84930W-7. International Society for Optics and Photonics
10. Errata: Review of ladar: a historic, yet emerging, sensor technology with rich phenomenology. PF McManamon. Optical Engineering 51(8), 089801-1089801-1. 2012
11. Active multi-aperture imaging through turbulence. NM Miller, JJ Widiker, PF McManamon, JW Haus. SPIE Defense, Security, and Sensing. 839504-839504-10. 2012
12. Wavefront control in a spatial heterodyne-based multi-aperture imager. GM Wu, NJ Miller, PF McManamon, EA Watson, JW Haus. SPIE Defense, Security, and Sensing, 839506-839506-10. 2012
13. Review of ladar: a historic, yet emerging, sensor technology with rich phenomenology. PF McManamon. Optical Engineering 51(8), 060901-1-060901-13. 2012
14. Acquisition, Tracking, Pointing, and Laser Systems Technologies XXVI. NJ Miller, JJ Widiker, PF McManamon, JW Haus, MR Whiteley, GM Wu… 2012.
15. Optical phased array technology, PF McManamon, TA Dorschner, DL Corkum… - Proceedings of the IEEE, 1996 Cited by 632
16. A review of phased array steering for narrow-band electooptical systems, PF McManamon, PJ Box, MJ Escuti, J Heikenfeld…Proceedings of the IEEE, 2009 Cited by 226

17. Applications look at the use of liquid crystal writable gratings for steering passive radiation PF McManamon, EA Watson, TA Dorschner, LJ Barnes – Optical engineering, 1993 Cited by 112
18. Review of lidar: a historic, yet emerging, sensor technology with rich phenomenology. PF McManamon – Optical Engineering, 2012, Cited by 76
19. An overview of optical phased array technology and status P McManamon - Congress on Optics and Optoelectronics, 2005 Cited by 65
20. McManamon, Paul F. "The Role of Laser Radar in Layered Sensing", Coherent Laser Radar conference, Snowmass, July 2007
21. Xinghua Wang, Bin Wang, Philip J. Bos, Paul F. McManamon, "Modeling and performance limits of a large aperture high-resolution wavefront control system based on a liquid crystal spatial light modulator " Optical Engineering, 1 April 2007, Vol: 46
22. P.F. McManamon, " Optical Phased Array Technology", Optics and Photonics News, OPN, Feb, 2006
23. P. F. McManamon, "Is Europe Running Fast Enough?, Electro-Optics, issue 179, January, 2006
24. P.F. McManamon, Jianru Shi, Phil Bos, " Broadband optical phased array beam steering, Optical Engineering, paper 128004, December, 2005, Vol 44
25. P. F. McManamon "An overview of optical phased array technology and status", Proc. SPIE Vol. 5947, p. 135-144, Liquid Crystals: Optics and Applications; Warsaw, Poland, Sept, 2005
26. P. F. McManamon, William E. Thompson , "New technologies and architectures for laser systems: revolutionary beam control" (Keynote Address) , Publication: Proc. SPIE Vol. 5413, p. 1-14, Laser Systems Technology II; William E. Thompson, Richard L. Brunson, Sep 2004
27. P.F. McManamon, "Putting on the Shift", OE Magazine, April 2003, p 15 - 17.
28. P.F. McManamon, W.Thompson," Phased Array of Phased Arrays (PAPA) Laser Systems Architecture", vol. 22, Fiber and Integrated Optics, p 79-88, Taylor & Francis, 2003
29. P.F. McManamon, W.Thompson, " Phased Array of Phased Arrays (PAPA) Laser Systems Architecture, IEEE Aerospace refereed conference, Mar 2002
30. P.F. McManamon, E.A.Watson, "Design of Optical Phased Array Beam Steering with Limited Dispersion", IEEE Aerospace refereed Conference, Mar 2001
31. P.F. McManamon, " Radar Across the Wavelengths", Active EO Systems Group of the MSS, WPAFB, OH, April 2000
32. P.F. McManamon, "Chem/ Bio Sensing using Laser Radar", 3rd NATO IRIS, Quebec, Quebec, Oct 1998
33. P.F. McManamon," Laser Radar Development", Journal: Proc. SPIE Vol. 3380, p. 50-57, Laser Radar Technology and Applications III, Gary W. Kamerman; Ed. , Sept. 1998
34. P.F. McManamon, E.A.Watson, and M. Eismann, " Low Cost Multifunction Sensing" IEEE Aerospace refereed conference, April 1998

35. Hardie, Russell C.; Vaidyanathan, Mohan; P.F. McManamon," Spectral band selection and classifier design for a multispectral imaging laser radar," Journal: Optical Engineering 37(03), 752-762, Donald C. O'Shea; Ed. , March 1998

36. P.F. McManamon, " Laser Radar trends in the United States", 9th Coherent Laser radar Conference, Sweden, July 1997

37. P.F. McManamon, T.A. Dorschner, D.C. Corkum, L.J. Friedman, D.S. Hobbs, M.K.O. Holz, S. Liberman, H. Nguyen, D.P. Resler, R.C. Sharp, and E.A. Watson, "Optical Phased Array Technology" p268-298, *Proceedings of the IEEE*, Vol 84, No 2, (Feb, 1996)

38. P.F. McManamon, "DOD Aircraft Avionics R&D", Feb. 9, 1996, At the Air Traffic Control Association Symposium on R&D for ATC, Arlington, Virginia.

39. Vaidyanathan, Mohan; Grayson, Timothy P.; Hardie, Russell C.; Myers, Lawrence E.; P.F. McManamon, Multispectral laser radar development and target characterization Journal: Proc. SPIE Vol. 3065, p. 255-266, Laser Radar Technology and Applications II, Gary W. Kamerman; Ed. , August 1997

40. P. F. McManamon, "Multispectral Passive Sensing", Solid State session of the 21st Century Investment Strategy for Airborne Reconnaissance Sensors, sponsored jointly by the Defense Reconnaissance Agency (DARO) and SPIE, Fort Belvoir, Virginia (Nov. 29, 1995)

41. K. Barnard, E. Watson, and P.F. McManamon, " Nonmechanical microscanning using optical space-fed phased arrays", Optical Engineering/ Sept 1994/Vol 33, No9/3063-3071

42. P.F. McManamon, E.A. Watson, T.A. Dorschner, L.J. Barnes, "Applications Look at the Use of Liquid Crystal Writable Gratings for Steering Passive Radiation", Nov 93, , Optical Engineering

43. M.S. Salisbury, P.F. McManamon, B.D. Duncan (UD), "Signal to Noise Improvement of a One Micron Ladar system Incorporating an Optical Fiber Preamplifier" Optical Engineering , Nov 93

44. J.A. Overbeck, S.H. McCracken, P.F. McManamon, B.D. Duncan (UD), "Comparison of Detection Techniques Using 2um Ladar" Optical Engineering , Nov 93 by

45. P.F. McManamon, "A Comparison of 3-5um PtSi Vs 8-12um Common Module Thermal Imagers," 4 Mar 87, Imaging IRIS, Orlando FL,

46. P.F. McManamon, "The Utility of Advanced Infrared Sensors for Air Force Application," May 83, Paper delivered at the 1981 National IRIS, Confidential

47. P.F. McManamon, "Advanced Thermal Imaging Concepts and Performance," Dec 81, Paper delivered at the 1981 Imaging IRIS

48. "Wavelength Correction with Photon Echoes," Oct 77, Optics Communication Vol 23, #1, pg 49, C.V. Heer and P.F. McManamon

PROFESSIONAL SOCIETY MEMBERSHIPS/POSITIONS:

2006 President of SPIE - The International Society for Optical Engineering, the world's largest optical society.

Board of Directors, 2000-2003, SPIE

Secretary, SPIE 2004

Vice President SPIE, 2005

Immediate past President of SPIE – 2007

Executive Committee of SPIE, 2003-2007

One of 3 originating members, and current member, of the **Executive committee, MSS (Military Sensing Symposia)**

Fellow, SPIE, the International Society for Optics and Photonics

Fellow, IEEE, the Institute for Electrical and Electronics Engineers

Fellow, OSA, the Optical Society of America

Fellow, MSS, the Military Sensing Symposia

Fellow, Air Force Research Laboratory, AFRL

Fellow: Directed Energy Professional Society, DEPs

Fellow, American Institute of Aeronautics and Astronautics, AIAA

Chair, SPIE awards committee 2001 & 2002

Chair, SPIE scholarship committee, 2003 & 2004

Chair, SPIE Kingslake awards subcommittee for 3 years

Chairman of Active IRIS for 4 years (most ever) 1995-1999

Member for organizing committee for the national MSS conference (15 years)

Chairmen of the 1997 SPIE AeroSense Symposium (>3500 technical attendees)

Chairman of the 2nd NATO/IRIS meeting, 1996, in London (secret conference). This was the very first parallel track MSS meeting

Member of the TTCP SEN Panel (Sensors panel) for 10 years

Former member of NATO panel 4 (EO Sensors), until it was abolished

Member, Old Crows

Member, American Physical Society, APS

Chair for the Optics Track at the IEEE Aerospace Conference (3 years)

Chair of the 14th annual, 1997, Dayton Chapter IEEE/AESS conference, on Synthetic Vision

Chair of the first Great Lakes Photonics Symposium, GLPS, 2004.

Associate Editor of a special issue of IEEE Proceedings to be published in 2008 or 2009 on "Optics and Photonics for Security and Defense"

Associate Editor of the 2004 “Encyclopedia Of Modern Optics” by Elsevier

AWARDS:

Awarded the 1998 W.R.G. Baker award for best paper in ANY IEEE JOURNEL or PUBLICATION. This includes over 100 separate refereed journals, containing over twenty thousand separate articles. This paper has been cited > 200 times in refereed journals

Distinguished alumni of St. Ignatius High School, Cleveland, Ohio

Meritorious Presidential Rank Award, 2006, presented by Air Force Secretary Wynn in a ceremony in Washington
Citation: The Meritorious Senior Professional Rank Award is presented to Dr. Paul F. McManamon for his dynamic and visionary leadership in the development of sensor and countermeasure technology for the United States Air Force, and for his international leadership of the optical engineering community.

2003 Harrell V. Nobel award for recognition in Electron Devices, from the Dayton, OH section of the IEEE.

Many civilian government awards